SANS Risk Approach Plan

Timeline (top):

- Start 10/1/20
- Today
- [297] Results of countermeasures validation in bedrest 9/18/24
- [255, 370, 27] Mars Transit Habs CMs Techs Delivered (CDR-6 months) [249] 12/31/27
- SANS Standards for maintaining inflight health to OCHMO 9/28/29
- Alternate Hypotheses Objective 6/26/36
- SANS Risk Closure (Schedule End) 9/30/40
- Finish 9/30/40

- High LxC 3/17/09 - 9/28/35
- HHC-SANS
- SANS Fluid Shift Hypothesis Characterized? 3/30/23
- Mid LxC Requires Mitigation 9/28/35 - 9/30/39
- SANS Standards for Long Term Health to OCHMO 9/28/35
- SANS Color Change (RtY) 9/28/35
- Low LxC 9/30/39 -
- SANS CM to SCLT/HMTA (YtG) 9/30/39

	Risk Characterization / Formulation	CM Development / Evaluation	CM Integration/Validation

HRR Gap: research logic description

SANS Fluid Shift Hypothesis Characterized?

- **SANS-101:** Determine the relationship between fluid shifts (intravascular, interstitial, CSF) and ocular manifestations in astronauts during spaceflight.

- **SANS-102:** Determine the relationship between fluid shifts-induced ocular changes and fluid shifts in the CNS, including whether elevated intracranial pressure or brain edema play a role. — HFBP

- **SANS-103:** Determine whether ground-based induced fluid shifts lead to ocular manifestations.

- **SANS-104:** Determine whether ocular manifestations can be induced by fluid shifts in rodents and whether this model can be used for more detailed mechanistic insights.

- **SANS-201:** Determine if altered atmospheric conditions (e.g., elevated ambient CO_2, hypoxia from exploration atmosphere) has a contributing role in the development of ocular manifestations — HFBP

- **SANS-202:** Determine if genetic/metabolic/anatomic dispositions and biomarkers, and sex differences have a contributing role in the development of ocular manifestations.

- **SANS-203:** Determine if radiation has a contributing role in the development of ocular manifestations — SR

- **SANS-204:** Determine if sleep/glymphatics has a contributing role in the development of ocular manifestations. — HFBP

Alternate Hypotheses Objective

- **SANS-301:** Develop and test mechanical countermeasures in the laboratory.

- **SANS-302:** Test mechanical CM in a strict bedrest analog

- **SANS-303:** Test the efficacy of AG (centrifugation)-induced fluid shift versus other mechanical countermeasures

Mechanical CM applied in Ground Analog mitigates Fluid Shifts-induced SANS

- **SANS-401:** Test non-mechanical countermeasures in a strict bed rest analog

- **SANS-402:** Test combination of mechanical and non-mechanical CM in a strict bedrest analog

Flight demo (feasibility/acceptability)

Flight Demo shows required fluid shift reversal achieved

- **SANS-501:** Test the finalized combined mechanical/non-mechanical countermeasures in the spaceflight environment (on ISS)

External Deliverables

- SANS Standards for maintaining inflight health to OCHMO
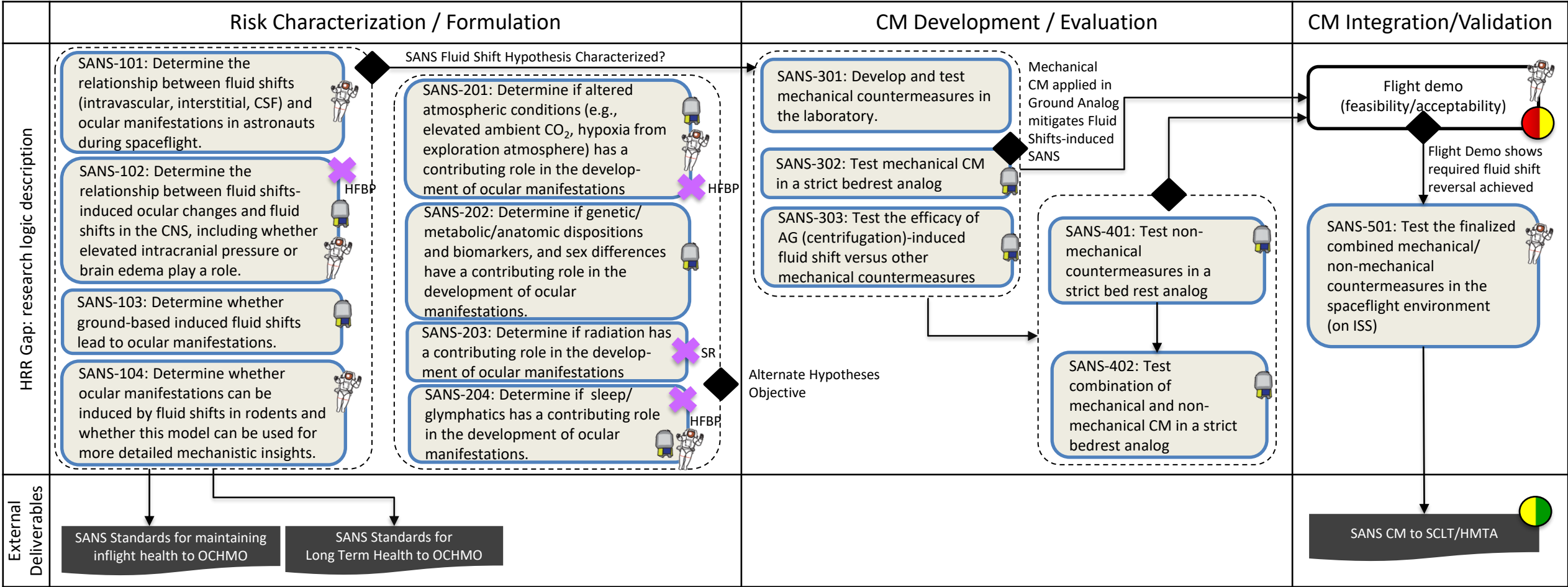- SANS Standards for Long Term Health to OCHMO
- SANS CM to SCLT/HMTA

Note: Milestone (◆) and Gap Closures (⬣) are Program reviews with defined entry/exit criteria.

Legend: 🤖 Analog 🧑‍🚀 Flight environment ✖ Cross Element Integration 🔴🟡 🟡🟢 🟡Ⓐ Anticipated PRR Color Change